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A Quantitative analysis of the value added services produced by digital color printers as perceived by print buyers

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A Quantitative Analysis of the Value Added Services Produced by Digital Color Printers as Perceived by Print Buyers

by

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A thesis project submitted in partial fulfillment of the requirements for the degree of Master of Science in the School of Printing Management and Sciences in the College of Imaging Arts and Sciences of the Rochester Institute of Technology

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Table of Contents

List of Figures

Abstract

This thesis project conducted a market research study of printers as well as print buyers. The digital printing presses that were used are the Xeikon, Indigo, GTO-DI, versus the conventional offset lithographic printing presses.

A market analysis was conducted to determine how much a particular job would cost if it were to be printed on any of these presses. These figures are based on different quantities (printing volume) and different time frames (turnaround times).

Samples from each press were presented to various print buyers with a questionnaire and scenarios. Based on the results, a break-even analysis between digital printing and offset lithography was conducted. The questionnaire determined how much more print buyers are willing to pay for quicker turn around and also when print buyers would choose digital over offset printing (i.e. type of work).

These results clarify many questions regarding cost/benefit ratios for digital printing. Furthermore, this study assists managers of printing firms in their deliberation of the world of digital printing. This analysis provides them with a better vision of the future market for digital printing.

Chapter One

Introduction

The introduction of digital color printing technologies now permit cost-effective, short-run color with quick turnaround using digital color presses such as Xeikon DCP-1, Indigo, and GTO-DI. Until recently, color printing, produced with conventional offset presses, was economically feasible only for run lengths greater than 5,000. Electronic printers, such as the Canon color copier, neither had the speed, price, nor the quality to produce short-run process color jobs.

> "Digital printing technology focus on color demand printing and publishing applications with run lengths around 5,000. The digital printing system brings the advantages of electronic publishing to the market including fast turnaround, variable information and the ability to customize color documents at economical prices."[1]

Digital color printing technology permits digital data to be printed directly to press and does not require intermediate steps such as films, stripping and plates. This reduces the high fixed make-ready costs that associated with traditional process color work. The total costs of printing are substantially lower for short runs compared to conventional offset printing, allowing for better profit margins on existing applications. The new cost dynamics will drive demand from black and white or spot color to full process color applications, utilizing existing electronic prepress and desktop publishing infrastructure.

> "Looking back in history, we see that originally all documents were personalized. Scribes and later monks hand-wrote books and manuscripts on one-on-one (on-demand) basis. Others illuminated (early process color?) the manuscripts to add color and graphics. In 1454, of course, Gutenberg came along and changed the world of printed communications by inventing movable type.

> Until recently there has been little change in the way we receive printed communications. But now the advent of digital printing presses may bring us full circle, for these devices promise individually personalized printed material for everyone. These recent developments in the area of "offset" printing technology are about to change the paradigm for printing in the future. The electronic printing press will change the way we buy, produce, and think about printing."[2]

Statement of Problem and Reason for Interest

No one has defined the market potential for digital color printing in terms of its potential for gaining market share within the conventional offset printing market based on price and turnaround. Most of the articles that are written talk about the pros and cons of the digital color printing technology in terms of its performance and capabilities.

This thesis project addressed the market potential and the break-even point between the digital color printing and the conventional color printing in terms of cost, run length and quick turnaround. In this research, print buyers of digital color printing were interviewed and feedback was gathered. This can help digital color printers to study the customer's level of education, understanding and awareness to the digital print technology.

The study proved that print buyers were willing to pay a premium for the added value services of short-run, quick turnaround, process color as produced by digital printing. This thesis project determined how much more they were willing to pay based on run length and turnaround time.

End Notes For Chapter One

[1] Kilgore, Mark. (1994, January). *American Printer*, p. 98.

[2] Gold, Ira A. (1994, January/February). *Color Publishing*, pp. 9-12.

Chapter Two

Theoretical Bases of the Study

Markets and Applications "Forces of Change"

Like other industries today, the graphic arts field is going through significant changes. The invention of new technologies such as data transmission, PostScript output devices and desktop computers awakened people and put them on their toes. This industry no longer consists of conventional print shops that try to produce ink on paper in the most productive way with good printing quality. This industry has become a service and information provider to customers who are trying to get into new markets using new technologies such as CD-ROM, quick printing, targeted market and variable data using the most updated databases.

In addition, print buyers have decided to be part of the electronic publishing revolution by investing in desktop publishing equipment to send electronic files to their printers. Therefore, many commercial printers tried to restructure their businesses and buy desktop computers and PostScript imagesetters to meet the changing needs of their customers.

However, market demand issues such as paper costs, postal rates, CD-ROMs and on-line services have pushed customers to look for other production and distribution alternatives. Therefore, the traditional methods used to prepare, create and distribute printed products are under threat.

Today, with information obsolescence and high warehousing costs, print buyers are trying to find other alternatives to solve their print and distribution problems and deliver up–to–date information with the exact quantity needed, keeping the cost down. In addition, they are using color in their printing to attract their audience.

With the introduction of the digital color printing, offering four colors capabilities, short run, and quick turnaround, information obsolescence and warehousing is no longer an issue nor a cost factor to print buyers. This new technology has opened a new market arena for the graphic arts industry. Most printers who are interested in this technology are waiting to see what will happen to this new innovation of digital color printing. Too many questions and concerns were raised by printers as to where the market for this technology is heading and even if there is such market.

Definitions and terms are misused with the introduction of any new technology. A good example is the introduction of the imagesetters and the misusage of the terms "dot per inch *DPI*" versus "line per inch *LPI*" and "resolution" versus "addressability" or even

"linearization" versus "calibration." In this chapter some of the definitions and terms of digital color printing will be discussed and clarified. Some of these terms were gathered from the experts in the digital color printing technology.

Definitions of Terms

"On-demand," "digital" or "custom" printing, are terms that are used interchangeably by many people. Arguments always arise over what exactly these terms mean. Apparently there are mixed opinions for the definitions of: "demand printing," "demand presses," "digital printing" and "digital presses." They sound alike, but they are not.

Defining On-demand

The concept of "on-demand" is basically one of short notice and quick turnaround. Therefore, if a movie or fax is needed right away a button is pressed or a phone call is made with short notice and the product will be delivered in a short time: "quick turnaround."

> "In the printing industry it is also associated with shorter and usually more economical printing runs. When we put all this together the definition becomes demand printing is: short notice, quick turnaround of short, economical print runs. When all criteria are met it results in lower inventory costs, lower risk of obsolescence, lower production costs, and reduced distribution costs.
>
> According to our definition it doesn't matter what technology you use. The customer probably doesn't care. It's rare for a customer to ask if you printed such-and-such on a Heidelberg or a MAN Roland or did you copy this on a Canon or a Xerox machine. They don't really care. As long as the quality is acceptable, and it's done fast and it doesn't cost too much, they will be happy."[1]

The terms "printing" and "copying" are used interchangeably by the print buyers. As an example, many customers refer to a Xerox DocuTech as an on-demand press. Yet, the DocuTech uses the electrophotographic or copying technology.

"Here are the definitions we use. An on-demand press is any device that can print short runs, on short notice, relatively quickly, in a cost efficient manner. This could be done with a traditional press, a high speed copier, a hybrid technology press, a high-quality printer, or a color copier. Lastly the terms "on-demand printing" and "demand printing" will be used interchangeably."[2]

Defining Digital Printing

Howard M. Fenton *GATF* and Frank Romano *R.I.T.* define "digital printing" as follows:

"Digital printing is any printing done from digital files. Two points to note. First, we avoid discussing specific technologies, and, second, when talking about digital printing we eliminate the short run aspect.

A digital press may be capable of printing short runs economically, but digital printing on printing presses is well suited for slightly longer runs. For example, a Heidelberg GTO-DI is definitely a digital press, but it may or may not be an on-demand press.

Therefore demand printing is economical, fast, and oriented to short runs while digital is printing from digital files but is not restricted to short runs. Demand printing could be done with digital files or conventional film or plates, while digital printing is only be done with digital files."[3]

The advantage of the above definition is that it addresses the Heidelberg GTO-DI. One argument can be said that the GTO-DI is considered a demand press because it can image directly to press and print out 5,000 copies in a quick turnaround and low cost. On the other hand, it can not perform variable printing.

A study report that was written by Graphic Arts Intelligence Network ***(GAIN)*** a consulting firm defined these terms as:

> "*Electronic printing* is the industrial production of printed products that are physically described and specified by digital data generated, processed and printed by electronic means. Electronic printing, as we understand it in the present survey, covers all 'direct-to-plate' solutions operating at industrial speeds. (The market sees industrial speed as starting at roughly 30 pages per minute.)
>
> *Electronic publishing* involves publisher's specific functions such as selecting the work to be published, the professionals to carry-out the production work, and the ultimate carriers upon which such work must be produced (paper of course, but also CD-ROM or video tape)."[4]

Market Research

One of the forces driving the interest and excitement in on-demand, digital and variable printing are the market research reports. There are several companies that specialize in market projections in the graphic arts, such as BIS Strategic Decisions, Charlie A. Pesko Ventures ***(CAPV)*** and State Street Consulting. Although each company and study is different they all come to the same conclusion that the market is growing and growing fast.

> "According to State Street Consulting, the short run printing market is $16 billion and will grow to $28 billion by 1995. But this could be an underestimation of the interest this technology will generate. It is only a market estimate of the amount of printing sales, it is not an indication of the number of sites that may consider this technology and probably does not put a value on in house work.

> Charlie Pesko believes that digital color presses will transform printing from a craft into a service. He refers specifically to on demand printing, which he defines as the ability to get what you want when you want and where you want it. In 1993, on demand services accounted for 7.2 billion dollars or 9% of the $80.2 billion commercial printing market. Pesko predicts that by the year 2000, on demand will represent 20% or $16 billion of that market."[5]

Potential Markets for Digital Color Printing

These are some of the market potential areas that can be used by digital color printing technology:

- Direct mail
- Advertising
- Catalogs
- Brochures and pamphlets
- Menus for restaurants
- Personalized invitations and greeting cards
- Letterheads and stationeries
- Newsletters
- Signs and posters
- Flyers and folders
- Labels
- Books and directories
- Magazine reprints and Journal
- Forms and coupons
- Schools and colleges
- Training booklets
- Manuals
- Some of the business forms (financial and legal)
- Variable printing

End Notes For Chapter Two

[1] Fenton, Howard & Romano, Frank. (1995, September). *On Demand Printing: The Revolution in Digital and Customized Printing*, p. 17-18.

[2] Fenton, Howard & Romano, Frank. (1995, September). *On Demand Printing: The Revolution in Digital and Customized Printing*, p. 18.

[3] Fenton, Howard & Romano, Frank. (1995, September). *On Demand Printing: The Revolution in Digital and Customized Printing*, p. 18.

[4] Graphic Art Intelligence Network (GAIN).

[5] Fenton, Howard & Romano, Frank. (1995, September). *On Demand Printing: The Revolution in Digital and Customized Printing*, p. 23.

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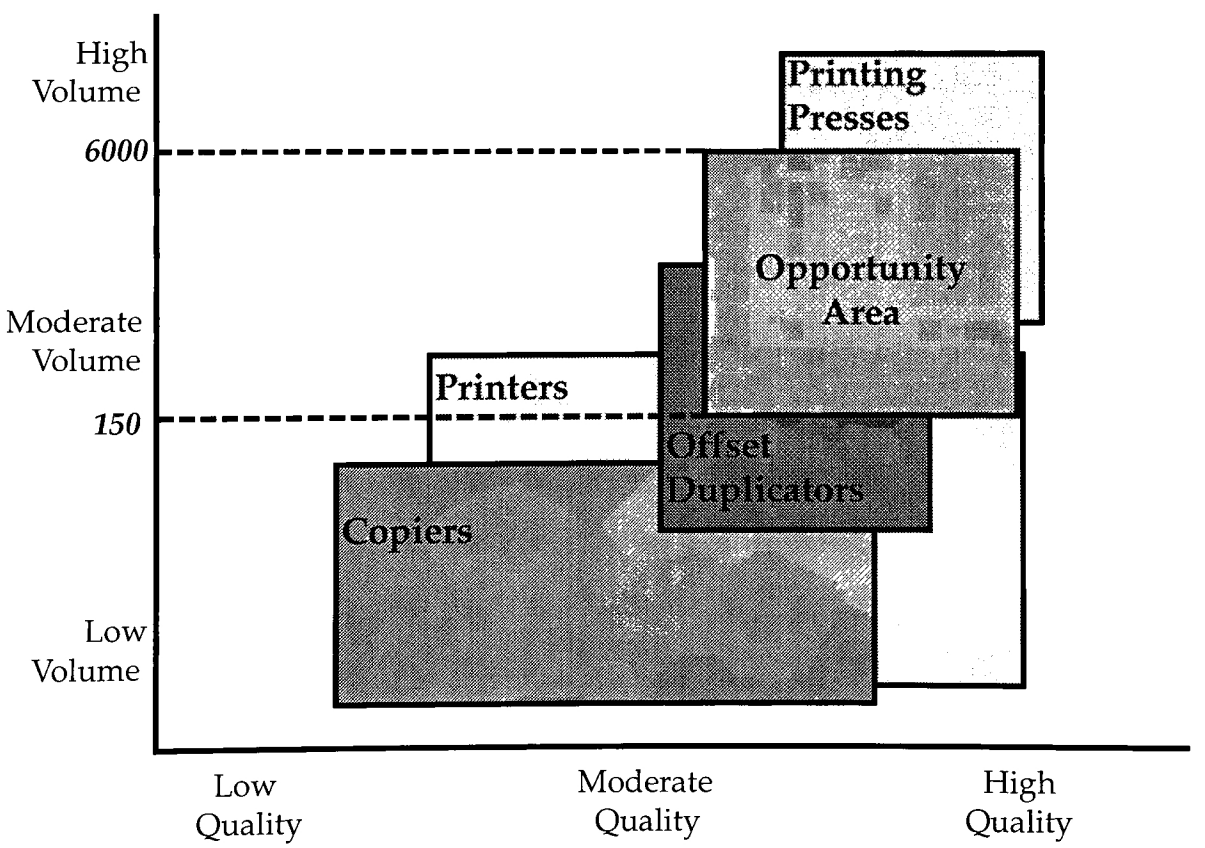
Chapter Four

Methodology

So far no one has defined the market potential for digital printing in terms of its potential for gaining market share within the conventional offset printing market based on price and turn around. Some experts have analyzed the digital printing market opportunities; others have categorized the market by press type and run length, but no studies exist which survey print buyers attitudes regarding price/availability scenarios.

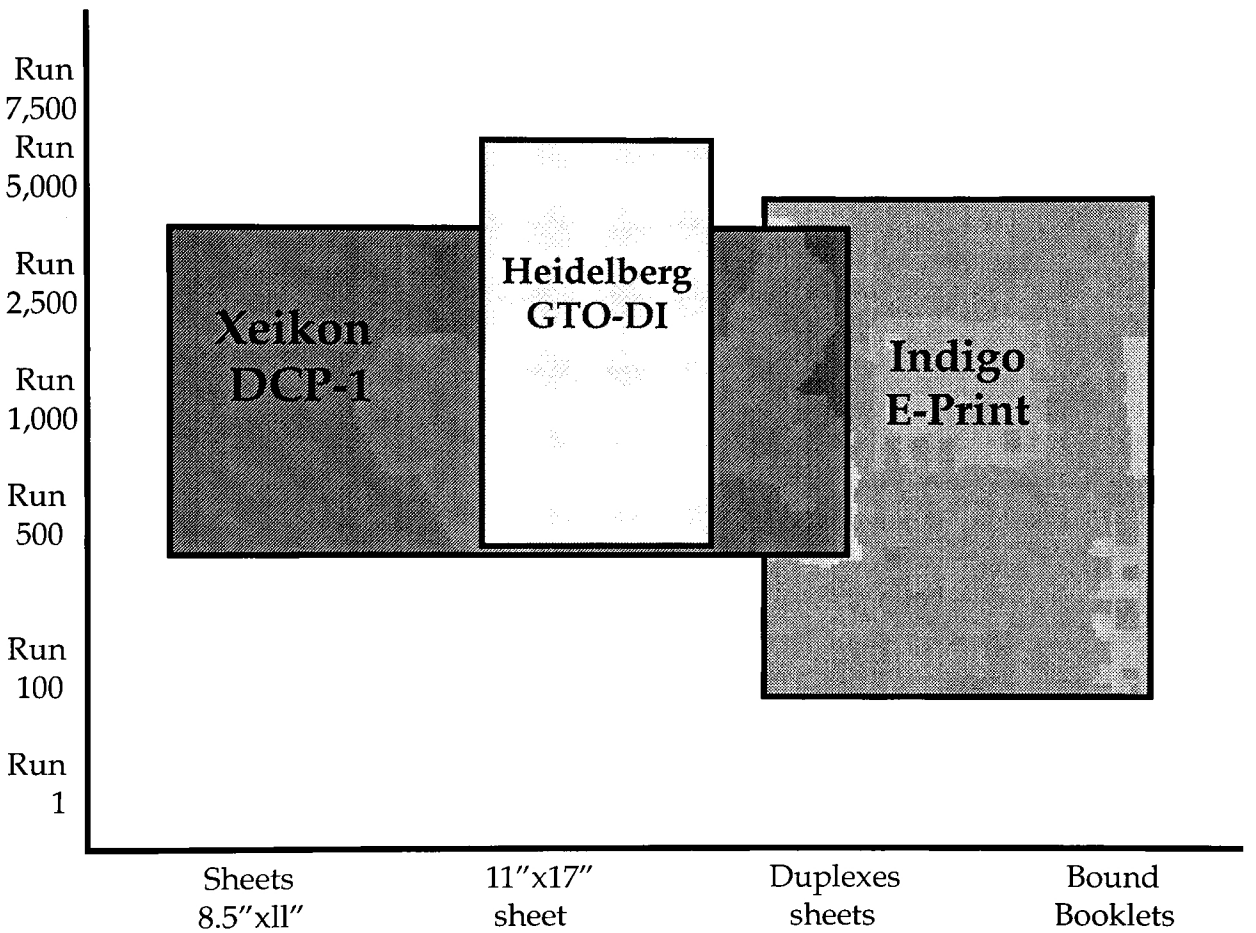
Charles A. Pesko Ventures *(CAPV)* has addressed the market opportunity for digital printing, in one of his research study reports for a major printing company, as it is shown in this graphical representation *(see figure 1)*. It verifies the market opportunities for digital printing in the segments between moderate to high quality and volume of 150 to 6000 copies:

Figure 1 *Short Run Color Market Opportunity* [1]



Another analysis was presented by Professor Frank Romano at the Graph Expo'94 digital color printing seminar which represents the major products in the short-run color printing market and the volume each press can produce. ***(See figure 2)***

Figure 2 ***Major Players in the Short-run Color Printing Market*** [2]



This thesis project conducted a market survey and analysis of printers and print buyers. This survey consisted of a:

- Questionnaire to:
  a) printers:
  To obtain job quotations based on time frame and quantity.
  b)Print buyers:
  To obtain responses to printers quotes.
- Job specification sheet indicating size, quantity, format and turnaround.

- Graphical representation of various scenarios to print buyers to select which method they would choose within different scenarios.

The results of the survey were analyzed and the data determined the break-even-point between offset lithography printing and digital printing based on print buyers responses to the following criteria:

- Price conditions.
- Volume (quantity).
- Time frame (quicker turnaround).

A study break down:

- **Prices** A survey was conducted on the cost of a particular job if it were to be printed on each of the following:
  Digital printing (Indigo, Xeikon, or GTO-DI)
  Conventional offset lithography
  The job sample is 11 inches x 17 inches duplex folded to 8.5 inches x 11 inches. Contains three four color process images and one spot color as a corporate identity. These estimates were averaged after they were quoted by several printers.

- **Quantity** The survey consisted of the following run length:
  100
  500
  1,000
  3,000
  5,000
  7,000

- **Time frame** This survey showed the comparative importance to print buyers of the time frame (quick turnaround) and the price. It also indicated their willingness to pay extra for quick delivery.

  The time frame scenarios were:
  One day turnaround.
  Two days turnaround.
  Three days turnaround.
  - One week turnaround.
  - Ten days turnaround.
  - Two weeks turnaround.

Figure 3 *Digital Color Quotes "Company A"*

Price/Time \ Quantity	100	500	1000	3000	5000	7000
$/1 Day						
$/2 Days	$1,348	$1,704	$2,160	$3,983	$5,805	$8,172
$/3 Days	$1,046	$1,361	$1,761	$3,360	$4,959	$6,900
$/1 Week	$756	$1,053	$1,430	$2,940	$4,448	$6,230
$/10 Days						
$/2 Weeks						

The chart above is the digital color quotes by company A indicating the prices scheme based on given quantities (run length) versus various turnaround time. *(See figure 3)*

The graph below describes the relation between quantities versus prices based on the turnaround time. As quantity increases, price per page decreases. *(See figure 4)*

Figure 4 *Digital Color Quotes Graph "Company A"*

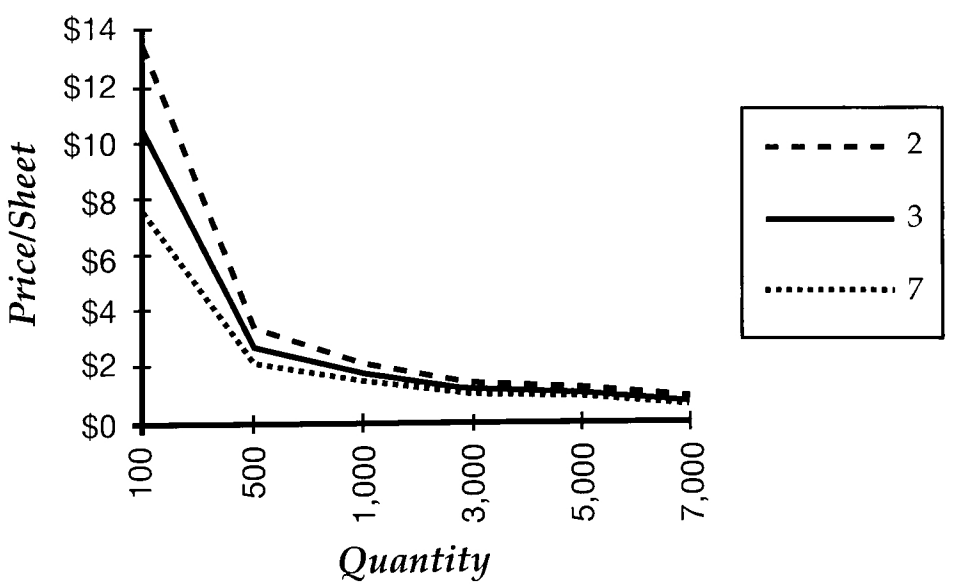


Figure 5 *Digital Color Quotes "Company B"*

Price/Time \ Quantity	100	500	1000	3000	5000	7000
$/1 Day						
$/2 Days	$2,318	$2,462	$2,644	$3,368	$4,092	$5,904
$/3 Days	$1,739	$1,847	$1,983	$2,526	$3,069	$4,428
$/1 Week	$1,159	$1,231	$1,322	$1,684	$2,046	$2,952
$/10 Days						
$/2 Weeks						

The chart above is the digital color quotes by company B indicating the prices scheme based on given quantities (run length) versus various turnaround time. *(See figure 5)*

The graph below describes the relation between quantities versus prices based on the turnaround time. As quantity increases, price per page decreases. *(See figure 6)*

Figure 6 *Digital Color Quotes Graph "Company B"*

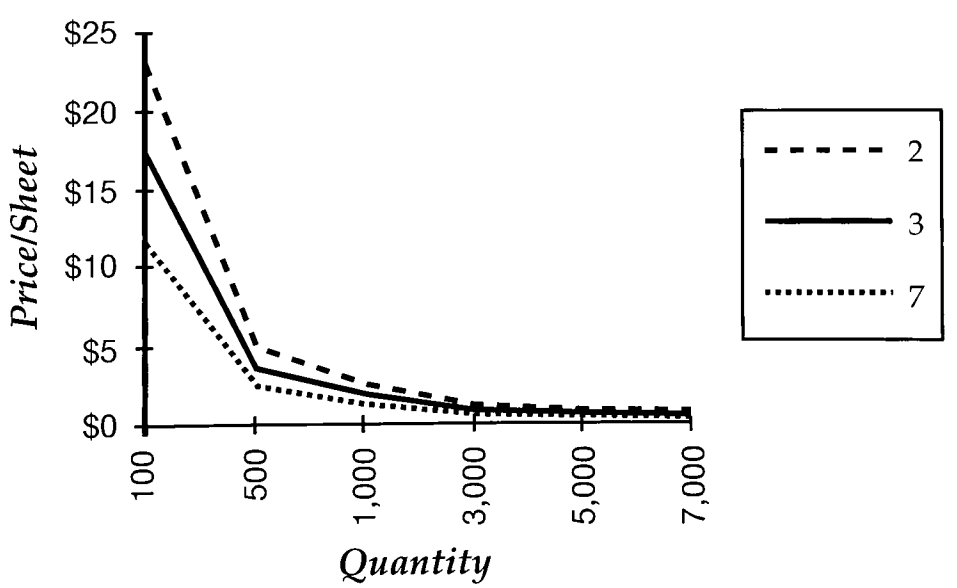


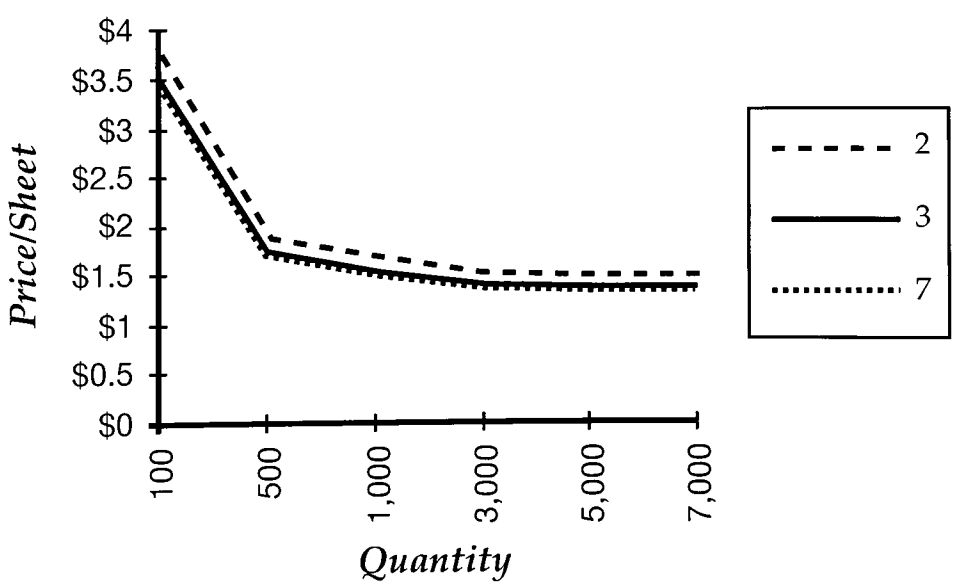
Figure 7 *Digital Color Quotes "Company C"*

Price/Time \ Quantity	100	500	1000	3000	5000	7000
$/1 Day						
$/2 Days	$378	$947	$1,677	$4,598	$7,519	$10,440
$/3 Days	$354	$876	$1,539	$4,194	$6,850	$9,506
$/1 Week	$354	$876	$1,539	$4,194	$6,850	$9,506
$/10 Days						
$/2 Weeks						

The chart above is the digital color quotes by company C indicating the prices scheme based on given quantities (run length) versus various turnaround time. *(See figure 7)*

The graph below describes the relation between quantities versus prices based on the turnaround time. As quantity increases, price per page decreases. *(See figure 8)*

Figure 8 *Digital Color Quotes Graph "Company C"*



The data quotes collection of the three digital color printing companies were averaged for the two days turnaround, the three days turnaround and the seven days turnaround and the results were plotted in the graph below. *(See figure 9)*

Figure 9 *Digital Color Quotes Graph "Average"*

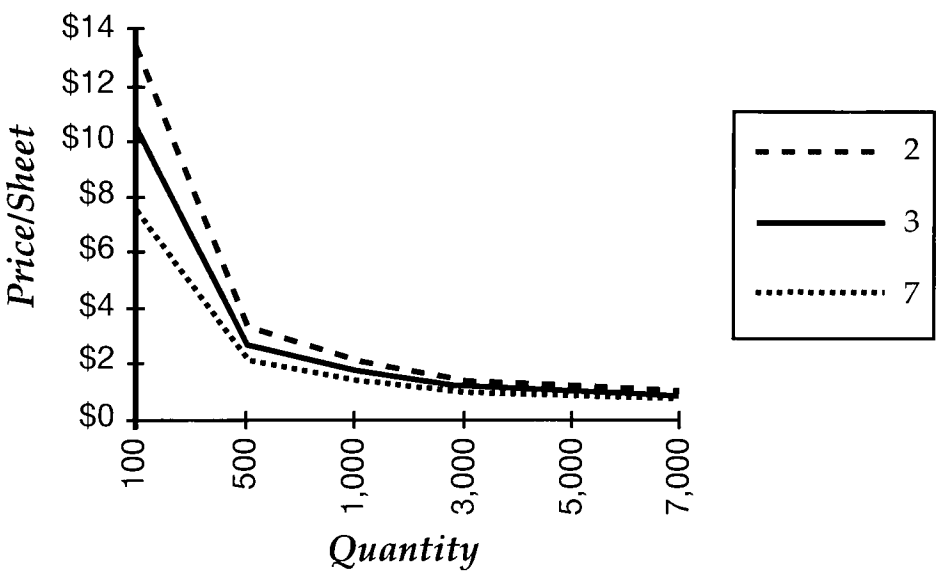


Figure 10 *Conventional Offset Quotes "Company A"*

Price/Time \ Quantity	100	500	1000	3000	5000	7000
$/1 Day						
$/2 Days						
$/3 Days						
$/1 Week		$1,632	$1,779	$1,926	$2,147	$2,368
$/10 Days		$1,632	$1,779	$1,926	$2,147	$2,368
$/2 Weeks						

The chart above is the conventional color quotes by company A indicating the prices scheme based on given quantities (run length) versus various turnaround time. *(See figure 10)*

The graph below describes the relation between quantities versus prices based on the turnaround time. As quantity increases, price per page decreases. *(See figure 11)*

Figure 11 *Conventional Offset Quotes Graph "Company A"*

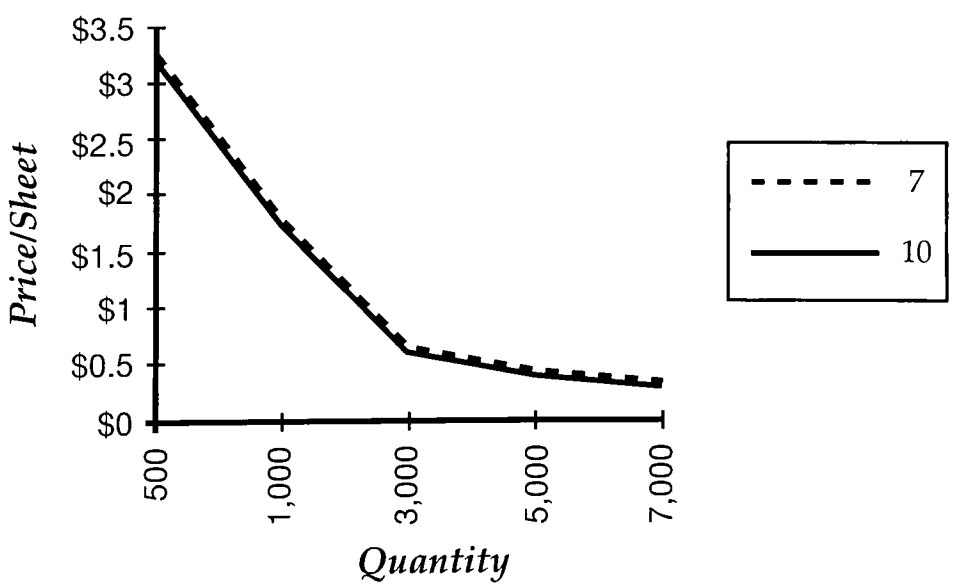


Figure 12 *Conventional Offset Quotes "Company B"*

Price/Time \ Quantity	100	500	1000	3000	5000	7000
$/1 Day						
$/2 Days						
$/3 Days						
$/1 Week		$1,783	$2,000	$2,234	$2,587	$2,940
$/10 Days		$1,783	$2,000	$2,234	$2,587	$2,940
$/2 Weeks						

The chart above is the conventional color quotes by company B indicating the prices scheme based on given quantities (run length) versus various turnaround time. *(See figure 12)*

The graph below describes the relation between quantities versus prices based on the turnaround time. As quantity increases, price per page decreases. *(See figure 13)*

Figure 13 *Conventional Offset Quotes Graph "Company B"*

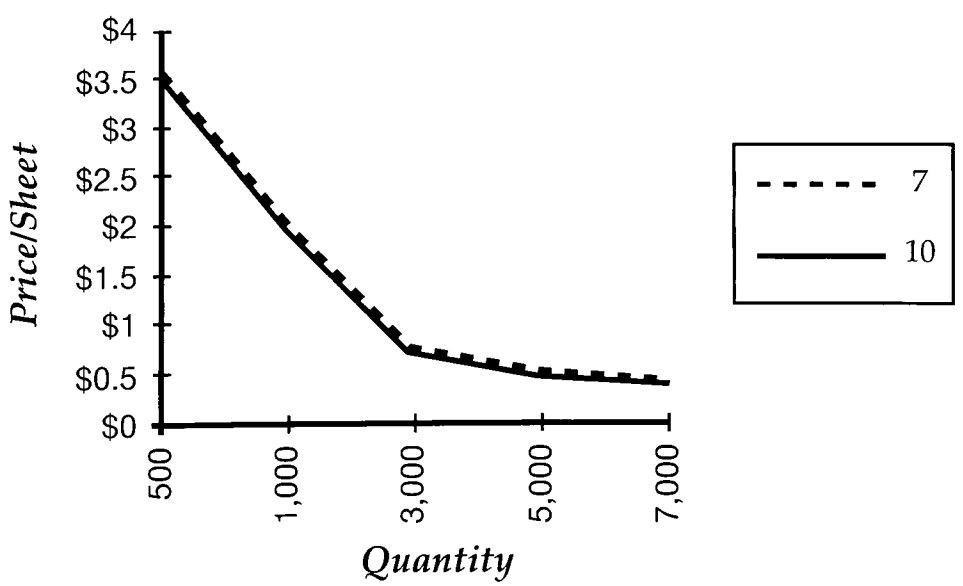


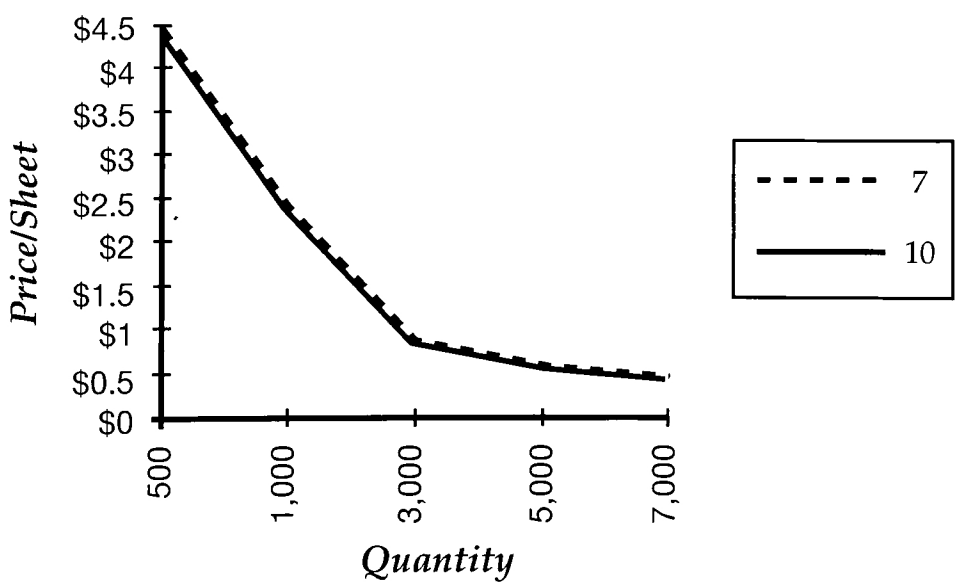
Figure 14 *Conventional Offset Quotes "Company C"*

Price/Time \ Quantity	100	500	1000	3000	5000	7000
$/1 Day						
$/2 Days						
$/3 Days						
$/1 Week		$2,251	$2,422	$2,593	$2,976	$3,359
$/10 Days		$2,251	$2,422	$2,593	$2,976	$3,359
$/2 Weeks						

The chart above is the conventional color quotes by company C indicating the prices scheme based on given quantities (run length) versus various turnaround time. *(See figure 14)*

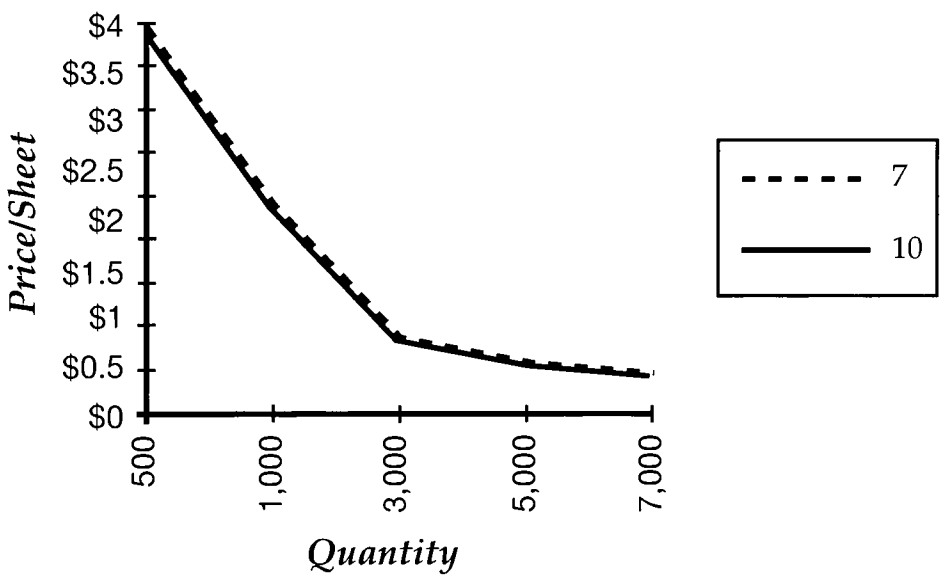
The graph below describes the relation between quantities versus prices based on the turnaround time. As quantity increases, price per page decreases. *(See figure 15)*

Figure 15 *Conventional Offset Quotes Graph "Company C"*



The data quotes collection of the three conventional offset printing companies were averaged for the seven days turnaround and the ten days turnaround and the results were plotted in the graph below. *(See figure 16)*

Figure 16 *Conventional Offset Quotes Graph "Average"*



End Notes For Chapter Four

[1] Charles A. Pesko. (1995, June). Charles A. Pesko Ventures. *The Digital Color Printing Market Study Report: A proposal for Moore Business formes.* p. 10.

[2] Romano, Frank. (1994, September). Graph Expo'95. *Digital Color Printing Seminar,* p. 5.

Chapter Five

Results and Observations

Observations from the digital color printing survey that was conducted in Chapter Four are the following:

1) None of the surveys (printers) were willing to provide a quote on a one day job delivery and the reasons given were:
    a. Most customers do not supply printers with the correct files such as CMYK vs. RGB for images or CMYK vs. Pantone for spot colors.
    b. Most customers provide printers with files that are missing the high resolution original images or even the EPS graphic files.
    c. Missing fonts or fonts that are not supported by the printers.
    d. Files that have the wrong settings or bad images and need to be re-scanned.

    All these reasons limit a job for next day delivery.

2) In theory if a customer were to provide those printers with the perfect file then digital printers would be able to turn this job in one day. This customer has to be well trained and well informed with the guidelines of the digital printing process and the need to prepare perfect files that can be printed without "pre-flighting." The time will come where customers will understand the digital printing technology and the steps required to prepare their files.

3) A very high mark-up price will be applied to the customer as a charge if his job were to be delivered the next day. Some customers are willing to pay the premium for this services. For others, it will not hurt them to wait an extra two days for a cheaper rate. Most digital printers that were interviewed had one or two scenarios where customers requested a one day turnaround and these customers were willing to pay the extra money for this service yet their files needed alteration. Overtime was necessary to fix their files and meet the deadline.

4) Most digital printers rejected quotes that exceed the 7,000 copies.

5) If a request is made on a job to be delivered in two weeks or more, the cost will be the same as the one week delivery. In fact digital color printers would recommend the customer to go to a conventional printer if the quantities were in the range of 7,000 copies or more and turnaround time is not an issue.

6) As the quantity increases, the price per page decreases then the price rate will flatten after 10,000 copies and conventional printing becomes more feasible.

7) As the turnaround time becomes shorter, the price per page increases.

The observations based on the survey that was conducted on the conventional offset printing companies in Chapter Four are the following:

1) All the surveys indicated that conventional printers will not deliver a job in four to five days turnaround and the reasons are:
    a. File check using preflighting programs.
    b. Producing films and the possibility of stripping if no impositioning software available.
    c. Proofs and customers' OK and the possibility of a bad proof
    d. Plate-making.
    e. Press set-up and make ready time.
    f. Drying time and finishing.

   All these reasons limit the ability of the conventional offset process to compete with the digital printing process in turnaround time.

2) In theory if a customer were to provide those printers with the perfect plate with all the dot gain and tone reproduction corrections built in to match a particular press then we can say the conventional offset printing would be able to print a job within a very short time and compete with the digital presses. The question here is, will such theoretically perfect plates even be provided to a printer?

3) When these printers were asked if they can deliver the job in three to five days, some of their responses were:
    a. "Can you spell the word IMPOSSIBLE?"
    b. "Are you out of your mind?"
    c. "God created the world in seven days and you want us to print your job in five days?"
    d. "You must be joking . . . !"

4) All conventional printers surveyed rejected quotes that were less than 500 copies.

5) As the quantity increases, the price per page decreases.

6) As the turnaround time becomes shorter, the price per page increases.

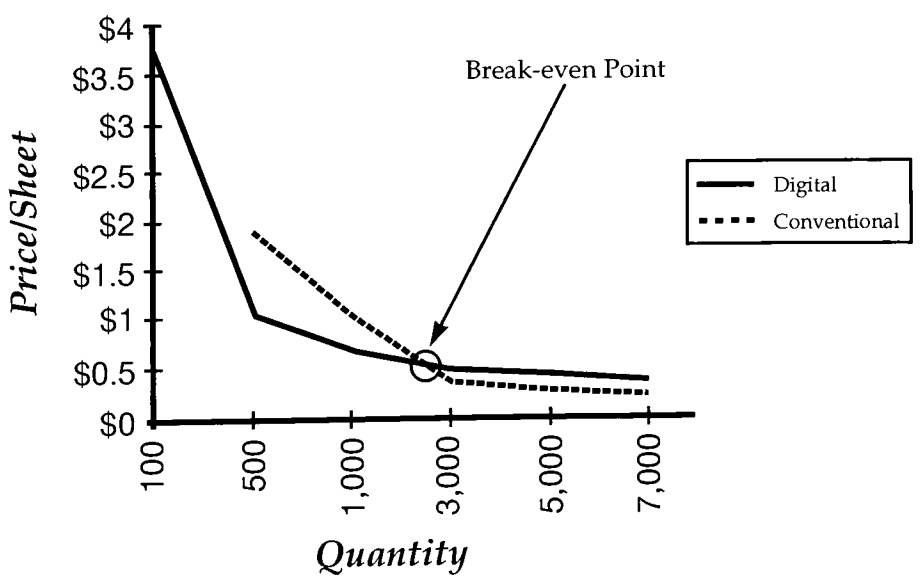
Chapter Six

Summary and Conclusions

To bring a fair comparison to the table between the two processes, digital and conventional processes, the seven day turnaround quotes are taken as the base of the analysis. Since both digital and conventional processes can deliver a job in one week. This is where the two processes overlap.

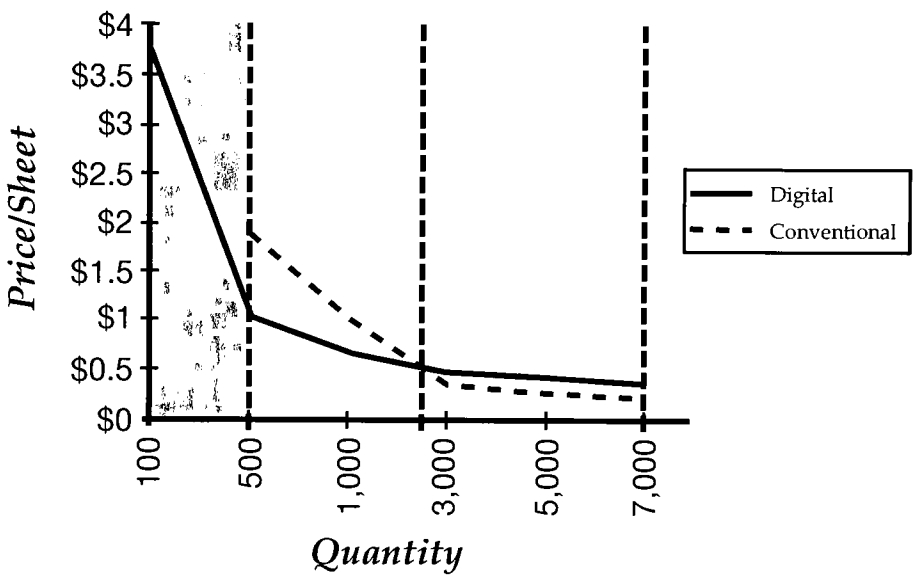
The average results were tabulated of both the seven day turnaround quotes for the digital printing process ***(See figure 9)*** and the seven day turnaround quotes for the conventional offset process ***(See figure 16)***. As a result, a final Break-even Point Analysis chart was plotted ***(See figure 17)***. This shows both the pricing behavior and the markets potential for each of the digital and the conventional printing processes.

Figure 17 *Break-even Point Analysis*



The illustration below *(figure 18)* shows the perspective of both the digital and conventional market potentials and concluded the following:

Figure 18 *Market Potential*



1) The one day to five days turnaround is strictly a solo market for the digital color printing.

2) The market becomes very competitive between digital and conventional printing as we progress towards the seven to ten days turnaround. The conventional printing process starts to gain market share over the digital printing process.

3) The market becomes in favor of the conventional printing process for anything after ten days delivery.

4) 500 copies and below is strictly a digital printing market. It is shown in the red section in the above chart *(See figure 18)*.

5) The digital printing process remains cost and time effective between the run length of 500 to 2900. The conventional process is not a threat in this market segment because of its high price and slow turnaround as shown in the yellow section in the above chart ***(See figure 18)***.

6) As the run length increases, the cost per page becomes cheaper using the conventional process. Therefore, the conventional process gains market share as the quantity exceeds the 3000 copies ***(See blue in figure 18)***. On the other hand, quick turnaround time is a value added factor that gives the digital process an advantage in this market segment.

Digital color printing is a fairly new technology in the printing industry. It is three to four years old. Several companies are investing heavily in research and development in these technologies. It is a matter of time when we will see digital printing start to replace conventional offset with speed, price, quality and the ability to print variable data and customized products.

History will repeat itself. The best example is the revolution of desktop publishing: the first Lisa Mac evolved to the Macintosh ***9500 powerPC***. Needless to say, stripping, trapping, color separations, impositioning, image manipulations . . . etc. were done by many people and took days if not weeks to get the job done.

Today, hardware and software have replaced manual labor and offered us productivity, accuracy and cost efficiency. If my predictions about the conventional sheet fed replacement theory were to happen in the future, then the break-even point would move to the right of the chart and the yellow area will become larger ***(See figure 18)***. It starts to become a part of the 4000 to 7000 run length market. The digital color printing will gain market share within the conventional printing market. It will take a large piece of the pie away from the conventional process and eventually become a major player in the 20,000 run length market segment.

The issue here is not the cost per page. A large number of customers are willing to pay extra money for the value added services that this technology offers such as:

- Short run, on-demand printed products which reduce warehousing, obsolescence information and waste.

- Variable data printing that targets a specific market segment for certain customers using data base information.

- Finally, quick turnaround time with just-in-time delivery. The printed product will be delivered as it is needed. This also will help the variable printing market

respond quickly and more effectively to their targeted demographic segments as well as reduce warehousing costs.

There are different providers of digital color printing and thousands of market potential opportunities. These digital print providers can be broken into four different categories.

1) ***Printers who think of digital color printing as a sheet fed replacement:*** Their approach to this kind of thinking will make them suffer at this stage of the game in the quick printing market. Technology is not yet up to speed with commercial sheet fed printing. But one day it will reach the level where digital printing is capable of competing with conventional sheet fed in large runs. This will happen with more research and development to enhance these digital presses. These printers will have to wait for product improvements to survive in the digital color printing market.

2) ***Printers who view this technology as a new market opportunity:*** They might invest in one or two presses at the most and gain a piece of the the pie from the on-demand market share. They might be limited to what they offer their customers such as variable data or other issues such as flexibility to run a job on a variety of presses i.e. Indigo, Xeikon or GTO-DI.

3) ***Printers who are large corporations such as (R. R. Donnelley and Moore Business Forms) who have the financial resources to invest in ten or twenty digital presses:*** They have x number of Xeikons, x number of Indigos and x number of GTO-DIs. In other words, a little bit of this and a little bit of that. With these large capability they can maintain the productivity and reliability of presses despite periodic maintenance. In addition, research and development can be done on any press while the others are in production. This will keep these large printers on top of the technology, ahead of the game and controlling the lion's share of the market.

4) ***Advertising firms and design agencies:*** This technology can suit these firms very well. They will see great opportunities to print their own documents from their workstations to their digital presses with the quantity they need and the time frame they desire and avoid dealing with printers. These presses will be another option in the *(print chooser)* with the other laser printers and color proofing devices they have in house. As all designers and creative artists understand printing and what goes beyond digital color presses technology, there will be a transformation in the world of graphic arts and publishing industry.

In conclusions, print providers of digital color printing must focus on identifying their new applications to better demonstrate and measure the value added services of this new technology to their customers. This will result in changing from traditional process to the new digital color technology of just-on-time, short run color printing.

With the introduction of new technologies, there will always be little resistance and discomfort from both print providers and print buyers. This is a normal curve that any industry experiences when it faces new changes. It takes some time for any technology to prove to its end users the benefits of its applications. Managers do not like to invest in new technologies till they are comfortable with the results and feel confident with the market potential.

There are markets that are waiting to be explored by the new world of the digital color printing. Markets such as short run, quick turnaround and variable data printing can not be served by the conventional process. It is not feasible nor cost effective to use sheet fed printing for short run four color process.

The challenge here is educating and informing the print buyers of such existing technology that they can take advantage of, whether it is short run using four color process, targeting the market using variable data, or avoiding obsolescent information and warehousing cost. Once this is accomplished, there will be vast market opportunities for the digital color printing to be created. This will not happen over night and it will take some time for this market to prosper.

The other challenge is for the printers who are trying to be part of this market and the use of the technology. Their challenge is to learn more about the capabilities, limitations and the new tricks of these digital presses and how far can they push them to produce better products to satisfy their customers.

As it is proven in this thesis project there is a market for digital color printing for run length up to 7000 copies and anything less than 3000 copies is strictly a digital color printing market. Variable priniting will not be achieved by the conventional presses because of the nature of the technology. Variable printing needs certain "raster image processors" that are connected to print engines where as conventional presses do not have these capabilities.

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Appendix

Appendix

Some questionnaires were collected from print buyers that were helpful to know when conducting this research. Thirteen print buyers were used for this survey.

1) Have you ever bought digital color printing?

Print buyers #

1	2	3	4	5	6	7	8	9	10	11	12	13
Y	N	Y	Y	Y	Y	N	N	Y	Y	N	Y	Y

- 69% say YES.
- 36% say NO.

a. If no, why not? Some of the responses were gathered.
   - Was not aware of such existing technology.
   - Are not sure of the reliability of this technology.

b. If yes, how long have you been buying digital color printing?

1	2	3	4	5	6	7	8	9	10	11	12	13
O		O	L	L	O			L	O		O	O

- 67% of who used it have been using it for over one year.
  "O" for over one Year.

- 33% of them have been using it for less than a year.
  "L" for less than a year

2) What gave you the idea?

1	2	3	4	5	6	7	8	9	10	11	12	13
		VD							VD			
LS		LS	LS	LS	LS			LS	LS		LS	LS
QT		QT	QT	QT	QT			QT	QT		QT	QT
		WO		WO	WO			WO	WO	-	WO	WO

- 22% said variable data. "VD"
- 100% said low quantity or short run. "LS"
- 100% said quick turnaround time. "QT"
- 77% said warehousing and obsolescence information. "WO"

3) What kind of digital color presses is your printer using?

1	2	3	4	5	6	7	8	9	10	11	12	13
								I	I		I	
G				G								
		X	X	-					X		X	
	-		-						V		V	

- 33% use Indigo. "I"
- 22% use GTO-DI. "G"
- 45% use Xeikon. "X"
- 25% use a variety of the above three. "V"

4) Are you doing your own prepress?

1	2	3	4	5	6	7	8	9	10	11	12	13
		Y	Y	Y	Y	-	-	Y	Y		Y	Y
N						-	-	-	-			

- 89% said YES.
- 11% said NO.

5) What kinds of prepress do you do?

1	2	3	4	5	6	7	8	9	10	11	12	13
							-	P	P		P	
S		S	S	S	S		-	S	S		S	S
T		T	T	T	T			T	T		T	T
D	-	D	D	D	D			D	D		D	D
	-			-								

- 33% do process color separations. "P"
- 100% do spot colors. "S"
- 100% do typesetting. "T"
- 100% do design. "D"
- 0% do trapping. "R"

6) What type of products are you giving to electronic printers?

1	2	3	4	5	6	7	8	9	10	11	12	13
-	-			-		-		-				
S	-	S	S	S	S	-		S	S		S	S
F		F	F	F	F	-		F	F		F	F
SQ		SQ	SQ	SQ	SQ	-		SQ	SQ		SQ	SQ

- 0% give black and white work (they use the DocuTechs).
- 100% give spot color work. "S"
- 100% give four color. "F"
- 100% request short run quick turnaround. "SQ"

7) How would you rate digital color printing as compared to conventional offset in terms of :

- Quality

1	2	3	4	5	6	7	8	9	10	11	12	13
B												
												F
		G	G	G	G			G	G		G	-

11% say bad. "B"
11% say fair. "F"
77% say good. "G"

- Delivery time

1	2	3	4	5	6	7	8	9	10	11	12	13
				-			-		-			-
M			-	-			-		-			-
		F	F	F	F			F	F		F	F

0% say slow. "S"
11% say moderate. "M"
88% say fast. "F"

- Cost

1	2	3	4	5	6	7	8	9	10	11	12	13
E												E
		M	M	M	M			M	M		M	

22% say expensive. "E"
77% say moderate. "M"

Summary

Some questionnaires were collected from print buyers that were helpful to know when conducting this research ***(See appendix for more details)***:

1) Have you ever bought digital color printing?
    - 36% say NO.
    - 69% say YES.

    a. If no, why not?
        - Was not aware of such existing technology.
        - Are not sure of the reliability of this technology.

    b. If yes, how long have you been buying digital color printing?
        - 67% of who used it have been using it for over one year.
        - 33% of them have been using it for less than a year.

2) What gave you the idea?
    - Variable data.
    - Low quantity or short run.
    - Quick turnaround time.
    - Warehousing and obsolescence information.

3) What kind of digital color presses is your printer using?
    - 33% use Indigo.
    - 22% use GTO-DI.
    - 45% use Xeikon.
    - 25% use a variety of the above three.

4) Are you doing your own prepress?
    - 89% said YES.
    - 11% said NO.

5) What kinds of prepress do you do?
    - 33% do proces color separations.
    - 100% do spot colors.
    - 100% do typesetting.
    - 100% do design.
    - 0% do trapping.

6) What type of products are you giving to electronic printers?
    - 0% give black and white work (they use the DocuTechs).
    - 100% give spot color work.

- 100% give four color.
- 100% request short run quick turnaround.

7) How would you rate digital color printing as compared to conventional offset in terms of :
   - Quality
     - 11% say bad.
     - 11% say fair.
     - 77% say good.
   - Delivery time
     - 0% say slow.
     - 11% say moderate.
     - 88% say fast.
   - Cost
     - 22% say expensive.
     - 77% say moderate.